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Discussion paper

REEXAMINING THE EMPIRICAL RELATION BETWEEN LOAN RISK AND COLLATERAL: THE ROLE OF THE ECONOMIC CHARACTERISTICS OF COLLATERAL

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**Reexamining the Empirical Relation between Loan Risk and Collateral:
The Role of the Economic Characteristics of Collateral***

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Abstract

This paper offers a possible explanation for the conflicting results in the literature concerning the empirical relation between collateral and loan risk. We posit that certain economic characteristics of collateral may be associated with the empirical dominance of different risk-collateral channels implied by economic theory, namely the “lender selection,” “borrower selection,” “risk-shifting,” and “loss mitigation” channels. Each of these four channels has different predictions regarding the empirical relations between collateral and loan risk. For our sample of commercial loans, we find that the “lender selection” channel appears to be especially important for outside collateral, the “risk-shifting” and “loss mitigation” channels are important for liquid collateral, and the “borrower selection” channel appears to hold weakly for nondivertible collateral. Our results suggest that the conflicting results in the extant risk-collateral literature may occur because different samples may be dominated by collateral with different economic characteristics.

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Reexamining the Empirical Relation between Loan Risk and Collateral: The Role of the Economic Characteristics of Collateral

I. Introduction

Collateral is a prominent feature of debt contracts. In the wake of the recent financial crisis, it has become increasingly clear that significant declines in the value of widely pledged assets can amplify the business cycle through procyclical changes in credit availability (e.g., Bernanke and Gertler, 1989, 1990; Kiyatoki and Moore, 1997; Gan, 2007). For example, as U.S. housing prices began falling in the latter half of the 2000s, mortgage defaults rose substantially and the value of mortgage-related collateral plummeted. As a result, households' ability to borrow against their homes and financial institutions' ability to pledge or sell mortgage-backed securities became impaired and a global financial crisis ensued.

While these events suggest that secured credit may be associated with higher risk, economic theory allows for collateral pledges to be associated with either higher or lower risk. Economic theory generally explains collateral as an attempt to reduce agency costs or contracting frictions in the presence of asymmetric information. One strand of theory motivates collateral as part of an optimal debt contract by invoking *ex post* frictions, like moral hazard, and predicts that observably riskier borrowers are more likely to be required to pledge collateral.¹ A second set of theories focuses on *ex ante* private information and suggests that collateral may allow lenders to sort observationally equivalent loan applicants through signaling.² Specifically, lenders offer a menu of contract terms such that observationally equivalent applicants with higher-quality projects choose secured debt with lower risk premiums, while those with lower-quality projects self-select into unsecured debt with higher risk premiums.

¹ See Boot, Thakor, and Udell (1991), Boot and Thakor (1994), Aghion and Bolton (1997), and Holmstrom and Tirole (1997) for examples of models with moral hazard. Other *ex post* frictions identified in the literature include difficulties in enforcing contracts (e.g., Banerjee and Newman, 1993; Albuquerque and Hopenhayn, 2004; Cooley, Marimon, and Quadrini, 2004) and costly state verification (e.g., Townsend, 1979; Gale and Hellwig, 1985; Williamson, 1986; Boyd and Smith, 1994).

² For examples of these theoretical models, see Bester (1985, 1987), Besanko and Thakor (1987a, 1987b), Chan and Thakor (1987), and Boot, Thakor, and Udell (1991).

To test these theories, a number of studies link measures of loan risk – such as loan risk premiums (loan rates minus the risk-free rate) and *ex post* nonperformance (delinquency or default) – to whether or not collateral was pledged. The findings are mixed. Some studies report a positive relation between loan risk premiums and collateral (e.g., Berger and Udell, 1990; Blackwell and Winters, 1997; Machauer and Weber, 1998; John, Lynch, and Puri, 2003; Brick and Palia, 2007; Godlewski and Weill 2011), while others find a negative relation (e.g., Degryse and Van Cayseele, 2000; Lehmann and Neuberger, 2001; Agarwal and Hauswald, 2010; Berger, Frame, and Ioannidou, 2011).³ One study finds no significant relation between collateral and loan risk premiums for loans drawn under commitment (Berger and Udell, 1995). In addition, two studies find that *ex post* nonperformance of loans is positively related to collateral (Jimenez and Saurina, 2004; Berger, Frame, and Ioannidou, 2011).

To our knowledge, there are no attempts to explain this puzzle in the literature – why the empirical relation between loan risk and collateral is sometimes positive and other times negative. This paper provides a potential solution by examining the empirical relation between loan risk and the economic characteristics of collateral, each of which may be associated with the empirical dominance of different risk-collateral channels implied by economic theory (outlined below). This suggests that the prior literature may have conflicting results because the different samples may be dominated by collateral with different economic characteristics.

Ex post theories of collateral imply the existence of three individual channels with different predictions for the empirical relation between loan risk and collateral. The first is the “lender selection” channel under which observably riskier borrowers are more often required by lenders to pledge collateral to reduce *ex post* frictions. The second is the “risk shifting” channel, which encourages borrowers to shift into safer investment projects when collateral is pledged. The third is the “loss mitigation” channel in which collateral reduces losses in the event of borrower default, as the lender is able to recover value

³ Agarwal and Hauswald (2010) report a negative relation between commercial loan rates and the incidence of collateral. The result is presumably consistent with a negative relation between loan rate premiums and collateral, given that risk-free rates changed only modestly during their 15-month sample period.

from the pledged assets. Hence, depending on how successful collateral is in resolving the *ex post* frictions for which it is pledged, the empirical relation between collateral and loan risk may be positive or negative. By contrast, *ex ante* private information theories of collateral predict an unambiguous negative relation between loan risk and collateral. This is due to the “borrower selection” channel in which unobservably safer borrowers tend to pledge collateral more often to signal their underlying quality. This prediction is further reinforced by the aforementioned “risk shifting” and “loss mitigation” channels, which may also be in effect under the *ex ante* theories. In our empirical analysis below, we attempt to isolate the four risk-collateral channels to the extent possible.

The degree to which information-based contracting frictions are mitigated by collateral should depend on the economic characteristics of the collateral. All else equal, we hypothesize that all four of the channels of collateral on loan risk should be stronger when the observable economic characteristics of collateral are more desirable. For example, the “borrower selection” channel should be stronger when the collateral is more desirable because the unobservably safest borrowers are expected to choose the lowest loan rates and pledge the most desired type of collateral. As well, the “lender selection” channel should be stronger when the collateral is more desirable as the lender is likely to insist on such collateral from the riskiest borrowers. The “risk shifting” and “loss mitigation” channels are similarly stronger when collateral is more desirable. We argue that liquidity, nondivertibility, and outside ownership status (discussed further below) are desirable collateral characteristics.

Some prior research analyzes individual economic characteristics of collateral and collateral types, although none look at a variety of collateral characteristics and types concurrently.⁴ Berger and Udell (1995) find that neither accounts receivable and inventory nor other types of collateral have significant effects on loan rate premiums for a sample of U.S. small businesses. John, Lynch, and Puri (2003) study U.S. corporate debt and find that non-mortgage collateral pledges are associated with higher interest rates than mortgage collateral pledges and unsecured loans – a result that is stronger for longer-term loans and loans to riskier firms. Voordeckers and Steijvers (2006) examine small commercial loans from a large Belgian bank and find that the pledging of outside collateral (assets not otherwise legally attachable in the event of default) is more likely for informationally opaque

⁴ However, one paper does relate the incidence of some individual collateral types to a measure of the expected default risk of individual borrowers (Liberti 2011).

firms (i.e., loans made to younger and family firms and small loans). Brick and Palia (2007) find that higher interest rates are charged for small business loans backed by outside collateral relative to inside collateral. Benmelech, Garmaise, and Moskowitz (2005) find that the terms of commercial real estate loans are affected by the zoning regulations associated with the underlying properties, which the authors use as a measure of redeployability. (We consider “redeployability” as being synonymous with “liquidity.”) The study finds that more redeployable (liquid) assets receive larger loans with longer maturities and lower interest rates.

Three other papers empirically demonstrate that airline financing conditions are related to the redeployability (liquidity) of the firm’s fleet. First, Benmelech and Bergman (2008) find that airlines are better able to renegotiate their airplane leases when the liquidation value of their fleet is low. Second, Benmelech and Bergman (2009) find that the pricing of collateralized debt obligations financing airplanes depends on the aircraft model as bonds backed by more redeployable (liquid) airplanes carry lower interest rates. Finally, Benmelech and Bergman (2011) show that airline bankruptcies produce a negative externality for other firms in the industry by increasing the available supply of airplanes. The authors identify this “collateral channel” using prices for collateralized debt obligations – finding that the effect is stronger for less redeployable (liquid) models, less senior tranches, and higher loan-to-value ratios.

This paper significantly extends the empirical literature by studying the relations between loan risk and collateral characteristics using detailed commercial loan data provided by a national credit registry. Specifically, we relate two different measures of loan risk that have been employed in the literature (loan risk premiums and *ex post* loan nonperformance) to a simple indicator of collateral being pledged, as well as three key economic characteristics of collateral derived from nine different collateral types. The first collateral characteristic is “liquidity,” or the ease, cost, and time with which the secured assets can be converted to cash at fair market value in the event of default. Bank deposits and securities are examples of liquid collateral. The second collateral characteristic studied is “divertibility,” or the ability of the firm to divert an asset (e.g., equipment) to alternative uses or reduce its maintenance, which can result in lower recovery values. The third collateral characteristic is an indication of ownership status i.e., whether the pledged asset would otherwise be legally attachable in the event of default. As discussed by Chan and Kanatas (1985), the economic theories of collateral described above generally assume that the asset being pledged comes from outside of the firm. This “outside collateral,” such as an owner’s home in the case of limited liability firms, acts like additional equity in the firm.

By way of preview, we find that overall the incidence of collateral is associated with lower loan risk premiums and a higher probability of *ex post* loan nonperformance (delinquency or default). For reasons explained below, these findings suggest that an important reason why collateral is pledged is because banks require collateral from observably riskier borrowers (the “lender selection” channel), while the main reason for the lower risk premiums is because secured loans yield lower losses in the event of default (the “loss mitigation” channel). However, the risk-collateral channels appear to depend on the characteristics of collateral. The “lender selection” channel appears to be especially important for outside collateral, the “risk-shifting” and “loss mitigation” channels are important for liquid collateral, and the “borrower selection” channel appears to hold weakly for nondivertible collateral. These results are robust to an additional instrumental variable analysis that attempts to control for the potential endogeneity of collateral using information from past loans. Because our mapping from the reported collateral types to the economic characteristics is somewhat subjective, we also provide supplementary results for the empirical relation between loan risk and each of the individual collateral types. Overall, our results suggest roles for all four risk-collateral channels implied by economic theory and document that the relative importance of these four channels varies significantly with the economic characteristics of collateral. This suggests a possible solution to the puzzle in the empirical literature.

The remainder of the paper is structured as follows. Section II describes the credit registry data we use. Section III outlines our empirical tests and Section IV presents our main results. Section V provides some additional evidence, while Section VI concludes.

II. Data

The data used in this paper come from the *Central de Información de Riesgos Crediticios* (CIRC), the public credit registry of Bolivia, provided by the Bolivian Superintendent of Banks and Financial Entities (SBEF). Since CIRC’s creation in 1989, the SBEF requires all formal (licensed and regulated) financial institutions operating in Bolivia to report detailed information on all loans. Our sample covers the entire credit registry for the period between January 1998 and December 2003. For each loan, we

have information on origination and maturity dates, credit type, interest rate, collateral type, and *ex post* nonperformance through the sample period (delinquencies and defaults). For each borrower, we have information about their industry, physical location, legal structure, banking relationships, and whether they have been delinquent or defaulted on another loan in the recent past.

The data include loans from both commercial banks and nonbank financial institutions (e.g., private financial funds, credit unions, mutual societies, and general deposit warehouses). To keep the set of lenders homogenous in terms of financial structure and regulation, we focus exclusively on loans granted by the 13 commercial banks operating in Bolivia between March 1999 and December 2003.⁵ Our sample of firms draws mostly from the larger and less risky firms in Bolivia, as smaller and riskier firms can only access microcredit institutions. Nevertheless, even for our sample of relatively larger firms, there is very little reliable information other than what is available through the credit registry. The vast majority of Bolivian firms does not have audited financial statements. Capital markets are not well developed and the banking sector is the principal source of debt finance for most of these firms (Sirtaine, Skamelos, and Frank 2004). Thus, our sample of firms has many of the typical characteristics of small and medium size businesses that borrow from commercial banks throughout the world.

For our analysis, we focus only on commercial loans. Commercial loans represent an important segment of the credit markets for which collateral is a negotiated loan term that is only sometimes present and where a wide variety of assets is pledged. There are several types of commercial credit contracts in the data, including credit cards, overdrafts, installment loans, discount loans, and lines of credit. We focus exclusively on installment loans and discount loans, which together account for 92 percent of the total value of commercial loans during the sample period. Ninety-eight percent of the installment and discount loans are denominated in U.S. dollars and we only use these loans in our analysis. To ensure the

⁵ Although we have data as of January 1998, we start our sample in March 1999 since prior to this date the data do not allow us to distinguish between commercial and consumer loans. However, we use the prior information from January 1998 through February 1999 to help fill in the history of bank-firm relationships as well as the firm's credit history as of March 1999.

use of timely information, we only use new loans and exclude renegotiations⁶ and loans drawn on pre-existing lines of credit.⁷ Given our focus on the economic characteristics of collateral and their underlying types, we exclude loans with multiple types of collateral. The resulting sample encompasses 28,252 loans (to 2,462 different firms) of which 18 percent are secured.

The types of security interests that Bolivian banks can invoke when accepting collateral are determined by the law.⁸ Acceptable security interests on real property include mortgages (*hypothecas*), pledges (*prenda*), and collateral bonds (*bonos de prenda*). Mortgages are used for immovable property (e.g., real estate) and some types of movable property (e.g., vehicles, aircrafts, and boats). Pledges and collateral bonds, on the other hand, are security interests on other kinds of movable property (e.g., equipment, inventory, and accounts receivable). There are two classes of pledges: with and without transfer of possession. Pledges with transfer of possession (often referred to as “common pledges”) require the transfer of movable property to the creditor or an authorized warehouse. Pledges without transfer of possession, on the other hand, are often used when the property is essential for the firm’s operations.⁹ A collateral bond (also known as a warrant) is a security issued by an authorized warehouse indicating possession of an asset and its value. By endorsing the collateral bond to a lender, the firm pledges the deposited assets to obtain secured credit. Hence, collateral bonds are similar to pledges with transfer of possession. In addition to security interest on real property, Bolivian banks can also use

⁶ Banks are required to indicate whether a loan is a renegotiation of a previous (performing or nonperforming) loan and we use this information to exclude renegotiations. To the extent that some renegotiations are not recorded (either because of reporting errors or because banks do that intentionally to reduce their loan loss reserves), our sample will include some loans renegotiations as new loans. Hence, in the sensitivity analysis below we try to control for this possibility by dropping all “suspected renegotiations” from our sample.

⁷ Loans drawn on pre-existing lines of credit are identified as follows. When a borrower draws on a pre-existing line of credit, a “new loan” appears in the registry with an origination date and contract terms as of the date the bank originated the credit line. Since the date the loan first appears in the registry is subsequent to the origination date, we can identify when a “new loan” is a draw on a pre-existing line of credit and then exclude it from our sample.

⁸ *Ley de Bancos y Entidades Financieras*, Law No. 1488 of April 14, 1993.

⁹ When there are concerns about agency problems, a warehouse can be set up at the firm’s premises to control access to the asset and at the same time allow the firm to continue using the asset.

security interest on financial assets such as bank guarantees (*garantías bancarias*), deposits in financial institutions (*garantías de depositos*), and financial securities (*garantías en títulos valores*).

All types of security interests used by Bolivian banks must be registered with the pertinent authorities, along with the encumbered assets. This is a time consuming and expensive process that often renders the use of collateral as impractical or prohibitively expensive, which may explain why the incidence of collateral in Bolivia is low relative to other countries.¹⁰ Registration allows for a more efficient enforcement in the event of default with the use of “Proceso Coactivo Civil.”¹¹ The “Proceso Coactivo Civil” is a faster enforcement procedure that escapes automatic stay and allows lenders to invoke their security interests once the borrower has materially bridged its contractual obligations.¹²

Table 1 provides variable names, definitions, and summary statistics for all loans in the sample.¹³ At the time of loan origination, only 0.3 percent of the loans are given to firms that have defaulted in the prior 12 months (*Prior_Default*). Hence, it seems that firms that default rarely get another loan— either because they are credit rationed or because they cease to exist as a going concern. About 21.1 percent of the loans are given to firms that had a delinquency with any bank in the previous 12 months (*Prior_NPL*). Most of the sample firms are limited liability corporations (48.8 percent), while joint stock corporations (22.2 percent), limited partnerships (13.6 percent), sole proprietorships (12.6 percent), and general partnerships (0.8 percent) are less common. The estimated average length of a banking relationship is almost 23 months. This is defined as the number of months since the first loan in the data for the bank-borrower pair as of January 1998. Turning to loan characteristics, almost half of the sample consists of

¹⁰ According to the World Bank (2005), registering property in Bolivia takes on average 91 days – well above the same figure for the Latin American and the Caribbean regions overall (56 days) or for OECD countries (34 days). Similarly, the average cost of creating collateral (as a percentage of gross national income per capita) is 51 percent for Bolivia as opposed to 19 percent for Latin America and the Caribbean and five percent for OECD countries.

¹¹ *Ley de Abreviación Procesal y Asistencia Familiar*, Law No. 1760 of February 28, 1997.

¹² All other firm assets and obligations instead are subject to automatic stay once bankruptcy proceedings begin. Given the lengthy bankruptcy proceedings that characterize Bolivia and many other Civil Law countries, the recovery rates on such credits are often low (e.g., Djankov, McLiesh, and Shleifer (2008)).

¹³ For relationship length, loan amount, and maturity we report summary statistics for the level of these variables, but our empirical models (below) incorporate the natural logarithm of one plus the level.

installment loans. The average loan amount is \$148,902, the average loan maturity is almost 11 months, and the average loan interest rate is 13.5 percent, with an average spread of 9.5 percentage points over U.S. Treasury securities of comparable maturities.

About 18 percent of our sample loans are secured by one of nine different types of assets. In particular, nine percent of collateralized loans are secured by deposits in the same or another financial institution, almost four percent are secured by bank guarantees (such as letters of credit), and about two percent with securities (such as bonds and stocks). Movable firm assets (such as accounts receivable, inventory, crops, tools, machines and equipment) are frequently pledged. For our sample, almost 16 percent of collateralized loans are secured by creditor-held movable collateral and almost 25 percent are secured by debtor-held movable collateral (i.e., pledges with and without transfer of possession). Real estate is also a frequent form of collateral, as 20 percent of collateralized loans are secured by residential real estate and almost nine percent by commercial real estate. Finally, almost 14 percent of collateralized loans are secured with endorsements from deposit warehouses backed by the deposit of commodities (i.e., collateral bonds), and two percent by vehicles. With respect to *ex post* performance of the 25,918 loans that matured before the end of the sample period, 5.9 percent had *ex post* delinquencies or defaults.

Next, we categorize these collateral types along three key economic dimensions: (1) liquidity, (2) divertability, and (3) ownership status. Table 2 provides a mapping from collateral types to these economic characteristics. An asset is considered liquid if it can be converted into cash quickly without substantial discount on its price. Hence, we create an indicator variable, *Liquid*, that takes a value of one when the collateral is either: *Pledged Deposits*, *Bank Guarantees*, or *Securities*. Asset divertability is another important collateral characteristic. Since nondivertible assets are less susceptible to borrower agency problems, they are better able to mitigate the *ex ante* and *ex post* frictions that arise because of informational asymmetries between borrowers and lenders. The variable *Nondivertible* takes a value of one for loans secured by the three liquid assets defined above as well as for loans secured by *Creditor-Held Movable Assets* (i.e., movable firm assets that are in the control of the bank during the term of the loan) and *Collateral Bonds*. Ownership status is also an important collateral characteristic. Assets or

other forms of collateral pledged from outside the firm may act as additional equity in the firm as they are otherwise not attachable to the firm in the event of default. The variable *Outside* takes a value of one for loans collateralized by either *Bank Guarantees* or *Residential Real Estate* pledged by limited liability firms (limited liability corporations and limited partnerships). Residential real estate loans are assumed to be backed by real property owned by the firm's principal shareholder and, in the case of limited liability firms, such assets would not otherwise be attachable in the event of bankruptcy.

As shown in the last row of Table 2, 14.3 percent, 44.2 percent, and 14.7 percent of secured loans employ liquid, nondivertible, and outside collateral, respectively. All else equal, liquidity, nondivertibility, and outside ownership status are considered desirable economic characteristics. Liquidity and nondivertibility are generally associated with greater certainty about the future value of collateral, while outside collateral pledges effectively act like additional firm equity and hence reduce moral hazard incentives. As noted above, it is generally expected that all four of the risk-collateral channels should be stronger when the collateral characteristics are more desirable.

III. Empirical Analysis

We examine the relation between loan risk and collateral by conducting two sets of empirical tests delineated by the risk measure studied – loan risk premiums and *ex post* nonperformance. Each set of tests explores the relation between the risk measure and the overall incidence of collateral, as well as the economic characteristics of the collateral pledges. Regressions include several control variables, including: firm, relationship, and loan variables, as well as fixed effects for region, bank, industry, and time and sometimes interactions of firm, bank, and time fixed effects.

Our loan risk premium regressions are estimated using OLS and can be summarized as:

$$Risk_Premium_{ijkt} = a(Collateral_{ijkt}, Firm_{jt}, Relationship_{jkt}, Loan_{ijkt}, Bank_k, Industry_l, Region_m, Time_t) \quad (1)$$

$$Risk_Premium_{ijkt} = b(Collateral_{ijkt}, Collateral\ Characteristics_{ijkt}, Firm_{jt}, Relationship_{jkt}, Loan_{ijkt}, Bank_k, Industry_l, Region_m, Time_t) \quad (2)$$

where i, j, k, l, m and t index loans, firms, banks, industries, regions, and time, respectively.

In equations (1) – (2), $Risk_Premium_{ijkt}$ is defined as the loan interest rate minus the rate on U.S. Treasury securities of comparable maturity for the month of loan origination.¹⁴ The key explanatory variables are those reflecting collateral pledges. Consistent with the extant literature, we first relate loan risk premiums to a simple indicator of whether the loan was collateralized or not – $Collateral_{ijkt}$ (equation 1). We then repeat the experiment using $Collateral_{ijkt}$ plus our three derived economic characteristics of collateral: $Collateral\ Characteristics_{ijkt} \equiv Liquid, Nondivertible,$ and $Outside$ (equation 2). We include the simple collateral indicator along with the economic characteristics because some types of collateral have none of these characteristics (i.e., they are illiquid, divertible, and inside).

The vector $Firm_{jt}$ accounts for differences in firm characteristics, particularly legal structure and past loan performance problems. We use a set of dummy variables indicating the legal structure of the firm: *General Partnership*, *Limited Partnership*, *Joint Stock Company*, and *Limited Liability Corporation* (*Sole Proprietorship* is the omitted group). *Prior_Default* indicates whether the borrowing firm had defaulted on a loan with any lender in the previous 12 months. *Prior_NPL* indicates whether the borrowing firm missed a payment on a loan with any lender in the previous 12 months. *Industry* is a set of 18 dummy variables controlling for the firm's industry classification (like the SIC or NAICS codes).¹⁵

The vectors $Relationship_{jt}$ and $Loan_{jt}$ account for differences in relationship length and other loan characteristics, respectively. *Relationship Length* indicates the length of a bank-firm relationship and it is equal to the natural logarithm of one plus the number of months we observe the bank and borrower in a credit relationship. *Installment* is a dummy variable equal to one if the contract is an installment loan

¹⁴ Available U.S. Treasury interest rates were interpolated to create interest rates for different maturities.

¹⁵ The 19 industry categories are: Agriculture and cattle; Farming; Forestry and fishery; Extraction of oil and gas; Minerals; Manufacturing; Electricity, gas, and water; Construction; Wholesale and retail trade; Hotels and restaurants; Transport, storage, and communications; Financial Intermediation; Real estate activities; Public administration defense, and compulsory social security; Education; Communal and personal social services; Activities of households as employees of domestic personnel; Activities of extraterritorial organizations and bodies; and Other.

rather than a discount loan. In some specifications, we also include two additional loan characteristics: *Amount* and *Maturity*. We exclude these variables from our main specifications because they are potentially endogenous as they may be determined simultaneously or even after the collateral decision.

We also include *Region*, a set of dummy variables that indicate the location from which the loan was originated. This includes nine regions in Bolivia as well as Argentina, Paraguay, Panama, and the United States. Moreover, bank and time (month-year) fixed effects are included in the model, represented by $Bank_k$ and $Time_t$, respectively. Bank fixed effects should capture any systematic differences across banks in the pricing of their commercial loans. The time fixed effects are intended to account for temporal differences in loan risk premiums related to business, interest rate, or credit cycles.

Additional specifications include firm fixed effects interacted with bank and time fixed effects (i.e., $Firm_j * Bank_k * Time_t$ fixed effects). Time-invariant firm and industry variables are omitted from these specifications. The identification of parameters in this most conservative case is obtained from the subsample of firms with more than one loan from the same bank in the same month. The addition of these interacted fixed effects help us to better identify the “risk shifting” and “loss mitigation” channels by virtually eliminating the “borrower selection” and “lender selection” channels as well as any other firm and bank heterogeneity that might be correlated with our collateral variables. A firm’s collateral pledge may be correlated with firm characteristics or time-varying bank characteristics that are not captured by our firm-specific controls or the bank fixed effects, respectively, which may lead to biased estimates. For example, smaller firms may be more constrained in their ability to pledge certain types of collateral. The inclusion of $Firm_j * Bank_k * Time_t$ fixed effects essentially eliminates this problem.

Our second set of empirical regressions use $Ex_Post_Nonperformance_{ijt}$ as a dependent variable. This variable indicates whether the loan eventually becomes delinquent or defaults, but does not measure the size of any losses. As above, this measure is separately regressed on a dummy variable indicating that collateral was pledged, the set of collateral characteristics as well as the collateral dummy, plus all other explanatory variables used in the risk premium regressions:

$$Ex_Post_Nonperformance_{ijt} = c(Collateral_{ijt}, Firm_j, Relationship_{jt}, Loan_{ijt}, Bank_k, Industry_l, Region_m, Time_t) \quad (3)$$

$$Ex_Post_Nonperformance_{ijt} = d(Collateral_{ijt}, Collateral\ Characteristics_{ijt}, Firm_j, Relationship_{jt}, Loan_{ijt}, Bank_k, Industry_l, Region_m, Time_t) \quad (4)$$

where i, j, k, l, m and t again index loans, firms, banks, industries, regions, and time, respectively.

Importantly, in these specifications, only the “borrower selection,” “lender selection,” and “risk shifting” channels are present. Consequently, these results – coupled with those for loan risk premiums – may allow us to better identify the singular importance of the “loss mitigation” channel of collateral. For this analysis, we drop all loans that do not mature before the end of the sample (December 2003); thereby leaving 26,033 bank loans. Since this has the effect of reducing the average loan maturity in our sample, we also eliminate all loans originated during the last six months of the sample (July – December 2003) – further reducing the sample to 25,391 loans.

A limitation of this analysis relative to the loan risk premium analysis is that we cannot include firm fixed effects to control for unobserved borrower heterogeneity that may be correlated with collateral pledges. The reason is that we have very few nonperformance observations that are repeated for individual borrowers.

IV. Results

Table 3 presents the results for the loan risk premium regressions. Columns I-II include only the collateral variables (collateral overall and collateral characteristics) along with the region, bank, and time fixed effects as well as a dummy variable indicating whether the loan is an installment loan (as opposed to a discount loan). All four risk-collateral channels are in force for these regressions. Subsequent specifications control for more and more of the two selection effects. Columns III-IV offer results for regressions that further include measures of firm ownership structure and risk, the length of the bank-firm relationship, and industry fixed effects. Columns V-VI incorporate $Firm_j * Bank_k * Time_t$ fixed effects, while removing all time-invariant firm characteristics as well as the individual bank and time fixed

effects. Columns VII-VIII additionally control for two potentially endogenous loan contracts terms (*Amount* and *Maturity*). The regressions in Columns V-VIII virtually eliminate the “lender selection” and “borrower selection” channels of collateral, as parameters are identified by effectively comparing loans to the same borrower by the same bank at approximately the same point in time.

Table 4 provides the results for the *ex post* nonperformance regressions. The table is structured like Table 3, except for the specifications with the $Firm_j * Bank_k * Time_t$ fixed effects. As mentioned previously, we cannot estimate the *ex post* nonperformance regressions using these interactions because there are too few nonperformance observations that are repeated for individual borrowers.

A. Collateral Overall.

The estimated relation between loan risk premiums and the overall incidence of collateral is displayed in Columns I, III, V, and VII of Table 3. In each of these regressions, we find a negative relation between the loan risk premiums and the overall incidence of collateral. The results in Column I suggest that collateral overall is associated with a 60 basis point discount. Given that “lender selection” is the only channel that implies a positive risk-collateral relation, the results are consistent with the net empirical domination of the combination of the “borrower selection,” “risk shifting,” and “loss mitigation” channels over the “lender selection” channel. Moving from Column I to Column III, we control for several firm characteristics, which reduces the “lender selection” and “borrower selection” channels; and in Column V these channels are virtually eliminated because we are controlling for $Firm_j * Bank_k * Time_t$ fixed effects. Looking across these columns, the negative overall relation between loan risk premiums and collateral is robust and quantitatively stable. This implies that the measured negative relation in Column I is mainly driven by the “risk shifting” and/or “loss mitigation” channels; and not by the “borrower selection” channel. Adding the potentially endogenous contract terms (*Amount* and *Maturity*) does not substantially alter the results (Column VII).

Table 4 presents the marginal effects of a Probit model for *ExPost_Nonperformance_{ijt}*. In Column I, the overall risk-collateral relation is positive, suggesting the net empirical dominance of the “lender selection” channel over the “borrower selection” and “risk shifting” channels. Recall that the

“loss mitigation” channel is not reflected in the *ex post* nonperformance variable. These results remain unchanged as we move from Column I to Columns III and V, controlling for firm, relationship, and other loan characteristics.

All in all, these results suggest that for collateral overall, the “lender selection” channel is an important motivation for collateral pledges, and that the “loss mitigation” channel is a main determinant of risk premiums. We draw these conclusions as follows. The findings in the risk premium regressions suggest that the “risk shifting” and/or “loss mitigation” channels dominate the “lender selection” and “borrower selection” channels. This is because collateral is associated with lower risk premiums, ruling out the relative importance of the “lender selection” channel (which predicts a positive relation), and the association does not change significantly when strong controls including $Firm_j * Bank_k * Time_t$ fixed effects are specified, ruling out the relative importance of the “borrower selection” channel as well (which predicts a diminished magnitude of the relation when strong controls are added). We also find that the “lender selection” channel dominates the “borrower selection” and “risk shifting” channels. This is because collateral is associated with more *ex post* nonperformance, and only the “lender selection” channel predicts a positive relation. The “borrower selection” and “risk shifting” channels predict negative associations and the “loss mitigation” channel is not reflected in the *ex post* nonperformance variable. Thus, the “lender selection” channel is an important motivation for pledging collateral (more important than the “borrower selection” and “risk shifting” channels), and the “loss mitigation” channel is a main determinant of risk premiums (more important than the “lender selection” channel which predicts the opposite relation; the “borrower selection” channel which predicts the diminishment of the negative relation between collateral and risk premiums when strong controls are included; and the “risk shifting” channel which is dominated by the “lender selection” channel).

B. Collateral Characteristics.

The estimated relation between loan risk premiums and the economic characteristics of collateral are displayed in Columns II, IV, VI, and VIII of Table 3. In each of these regressions, we find that the incidence of collateral in general is associated with lower loan risk premiums of roughly 40 basis points.

In Column II, we find that liquid and nondivertible collateral are each associated with further loan risk premium discounts, while firms that pledge outside collateral pay a higher loan risk premium (relative to both other secured loans and unsecured loans). Each of the three economic characteristics of collateral is statistically significant in these regressions, consistent with our separate treatment.

Moving from Column II to Columns IV and VI, we observe that *Liquid* collateral has a persistently negative and statistically significant coefficient in all three specifications. This is consistent with substantial “risk shifting” and/or “loss mitigation” channels for liquid collateral. These effects are identified by the fact that the relation is maintained in Column VI when the “borrower selection” channel is no longer in force. The coefficient for *Nondivertible* is negative in Columns II and IV and statistically indistinguishable from zero in Column VI. This finding may be viewed only as weak evidence of a “borrower selection” channel for this collateral characteristic since the statistical insignificance of the estimated coefficient in Column VI is driven by a marked increase in the standard error, rather than any material change in the point estimate. The positive overall effect of *Outside* collateral in Columns II and IV is consistent with a strong “lender selection” channel, suggesting that the riskiest firms pledge outside collateral. This is confirmed by the results in Columns VI, where the estimated coefficient on *Outside* is statistically indistinguishable from zero. Again, adding the potentially endogenous contract terms (*Amount* and *Maturity*) does not alter the results (Column VIII).

Next, we turn to the estimated relation between *ex post* nonperformance and our three economic characteristics of collateral in Columns II, IV, and VI of Table 4. Here again, the statistical significance of the economic characteristics justifies their inclusion. Individually, *Liquid* and *Nondivertible* collateral are each negatively and statistically significantly related to *ex post* nonperformance, although the joint significance of these variables with *Collateral* suggests a positive net effect relative to unsecured loans. The coefficient on *Outside* is marginally positively economically and statistically related to *ex post* nonperformance. The positive coefficient on collateral as a whole and the joint positive effects of *Liquid*, *Nondivertible*, and *Outside* collateral (with collateral overall) suggest the presence of a strong “lender selection” channel for all kinds of collateral.

Overall, we find that the relative importance of the four loan risk-collateral channels varies with the economic characteristics of collateral. *Liquid* collateral is associated with the largest reductions in loan risk premiums as well as an improvement in *ex post* nonperformance (relative to other collateralized loans), suggesting that the “loss mitigation” and/or “risk shifting” channels are relatively stronger for liquid collateral. However, because the joint significance of the coefficients of *Liquid* and *Collateral* suggests a positive net effect on *ex post* nonperformance (relative to unsecured loans), the “lender selection” channel continues to dominate over the “borrower selection” and “risk shifting” channels. *Nondivertible* collateral is associated with reductions in loan risk premiums that are modestly larger than those found for collateral overall and appears to be associated with the “borrower selection” channel; although, this inference may be clouded by a lack of statistical power. *Outside* collateral is associated with substantially larger loan risk premiums (relative to both collateral overall and unsecured loans), as well as significantly worse *ex post* performance. This implies that only the riskiest borrowers pledge *Outside* collateral, consistent with a strong “lender selection” channel.

Turning to the other explanatory variables, we see that each of the firm risk characteristics is generally positively related to loan risk premiums and *ex post* nonperformance. One exception is *Prior_Default* which is statistically insignificant in the *ex post* nonperformance regressions perhaps owing to the small number of loans to firms that had recently defaulted and received new credit. Relative to sole proprietorships, each of the other ownership structures are associated with lower loan risk premiums. However, this finding is unlikely to be related to default risk as limited liability firms (limited liability companies and limited partnerships) tend to have more *ex post* nonperformance problems. Longer banking relationships appear to be associated with higher loan risk premiums and lower rates of *ex post* nonperformance (although the latter is not statistically significant), consistent with “lock-in effects” (e.g., Rajan, 1992). Riskier firms are more likely to have installment loans as they are associated with higher loan risk premiums and higher rates of *ex post* nonperformance.

C. Robustness Tests

Our main results in Tables 3 and 4 are robust to two additional checks. Our most conservative specifications with the $Firm_j * Bank_k * Time_t$ fixed effects in Columns V-VIII of Table 3 are estimated for a subsample of borrowers with multiple loans from the same bank in the same month. This raises the question of whether the results in Columns I-IV of Table 3 – as well as the results in Table 4 – are robust to using this smaller sample of loans. When we conduct this experiment, we find that *Collateral* remains negatively related to loan risk premiums and this holds for *Liquid* and *Nondivertible* collateral, while *Outside* collateral is again associated with higher premiums. Re-estimating the *Ex_Post_Nonperformance* regressions for the subsample yields similar results to Table 4 – the positive relation with *Collateral* overall and the joint positive relations with all three collateral characteristics are maintained.¹⁶ These results are not shown for brevity and are available upon request.

Next, we re-estimate the specifications reported in Tables 3 and 4 after dropping all loans that appear to be continuations of previous loans. (Loans designated in the registry as renegotiations have already been excluded from our analysis.) Including continuations of previous loans could bias the estimated relations between *ex post* nonperformance and collateral. This bias would arise in situations in which the borrower became distressed and the bank demanded that collateral is pledged, but recorded the adjustment as a new loan with overdue payments. To identify such situations, we look for loans that are originated right after another loan at the same bank terminates and the two loans have the same contract amounts. We identify 2,184 such loans, of which only 76 have collateral added. Re-estimating equations (1) to (4) without these loans has virtually no effect on our results. These results are also not shown for brevity and are available upon request.

V. Additional Evidence

¹⁶ The coefficients on *Liquid* and *Outside* remain of the same signs as in the full sample, but become smaller in magnitude and are sometimes statistically insignificant.

In order to supplement our previous findings, we explore two additional issues. The first is the possible joint determination, or endogeneity, of loan risk premiums and collateral pledges. The second concerns our mapping from the reported collateral types to collateral characteristics.

A. Potential Endogeneity of Collateral in the Loan Risk Premium Regressions

Under the *ex ante* theories of collateral, loan interest rates and collateral are jointly determined, which implies that collateral may be endogenous in the loan risk premiums regressions.¹⁷ To investigate whether the joint determination of loan risk premiums and collateral affects our findings, we employ an instrumental variable (IV) approach. Specifically, we instrument for *Collateral* in equation (1) using information from prior loans that indicates whether the borrower has available collateral to pledge. In particular, we create a dummy variable that equals one if collateral was pledged on any of the borrower's outstanding loans between $t-13$ and $t-1$ that were successfully repaid prior to t . This indicator is expected to be positively correlated with collateral pledges on a new loan, but is not jointly determined with the interest rate on the new loan. Information on the types of collateral on prior loans is also used in a similar way to create instruments for the economic characteristics of collateral in equation (2). For example, to instrument for *Liquid* collateral we create an indicator that equals one if liquid collateral was pledged on any of the borrower's outstanding loans between $t-13$ and $t-1$ that were successfully repaid prior to t . Instruments for *Nondivertible* and *Outside* collateral were created in a similar way.

Because *Collateral* is a categorical variable we use the two-step procedure described in Wooldridge (2002, pp. 623-625).¹⁸ This involves first estimating a Probit model of *Collateral* using our instrument and all other explanatory variables from equation (1) as independent variables. The predicted values from this regression, \hat{P}_1 , are then used as an instrument in a standard IV model for equation (1)

¹⁷ Brick and Palia (2007) previously argued that loan risk premiums and collateral should be treated as jointly determined and provide supporting evidence for their sample of U.S. small business loans.

¹⁸ A standard IV model would ignore the fact that the dependent variable in the first stage regression is a categorical variable and would estimate the empirical relations using OLS (i.e., a linear probability model). In this case, the estimated coefficients are both inconsistent and inefficient and the predicted values from this model do not necessarily fall between 0 and 1 (Wooldridge 2002, pp. 623-625).

using 2SLS. In particular, *Collateral* is regressed on \hat{P}_1 and all other explanatory variables in equation (1). The predicted values of this model, \hat{P}_2 , are then used to estimate the second stage regression, where the loan risk premium is regressed on \hat{P}_2 and all other explanatory variables of equation (1). The standard errors in the second stage regression are appropriately corrected.

Table 5 presents the results for the IV estimation of loan risk premiums and compares them to the OLS estimates in Table 3 (Columns I-IV) for both the baseline specification as well as the expanded model that controls for firm ownership structure and risk, the length of the bank-firm relationship, and industry fixed effects.¹⁹ In all cases, the IV estimates for the relation between the incidence of collateral and loan risk premiums remains negative and statistically significant, although they suggest a stronger causal effect. The results for the individual collateral characteristics are again qualitatively similar with the use of instrumental variables, although the effects are somewhat stronger. These results suggest that the potential endogeneity of loan risk premiums and collateral pledges is not clouding our inferences.

B. Collateral Types

In our analysis above, we mapped reported collateral types into their underlying economic characteristics and then studied the empirical relation between these characteristics and loan risk. To be transparent, we also present results using the individual collateral types. Specifically, we replace the indicators for collateral in general and the three collateral characteristics in equations (2) and (4) with a vector of nine collateral types (described earlier): *Collateral Types*_{ijkt} \equiv *Pledged Deposits*, *Bank Guarantees*, *Securities*, *Creditor-Held Movable Assets*, *Debtor-Held Movable Assets*, *Residential Real Estate*, *Commercial Real Estate*, *Collateral Bonds*, and *Vehicles*. Because there is a specific collateral type for each secured loan, we exclude the overall collateral indicator from these regressions to avoid perfect collinearity. The results are reported in Table 6. The first four columns of the table report

¹⁹ In all cases, the instruments have positive and statistically significant coefficients in the first stage regressions. The first stage regressions are not reported for brevity and are available upon request.

corresponding specifications for the loan risk premium regressions in Table 3, while the last three columns report the corresponding specifications for the *ex post* nonperformance regressions in Table 4.

Our findings in Table 6 are in line with those reported earlier. In particular, Column I shows that loans secured by virtually all types of collateral carry lower loan risk premiums than unsecured loans, consistent with the empirical domination of the “borrower selection”, “risk shifting,” and/or “loss mitigation” channels over the “lender selection” channel for virtually all collateral types. The one exception is *Residential Real Estate* which is positively and statistically significantly related to loan risk premiums, consistent with the empirical domination of the “lender selection” channel for this type of collateral. This is also consistent with our findings for *Outside* collateral in Table 3.

Comparing the coefficients of the various types of collateral, we also observe that most liquid and/or nondivertible types of collateral, such as *Pledged Deposits*, *Bank Guarantees*, *Securities*, and *Creditor-Held Movable Assets*, have larger negative coefficients than less desirable types of collateral like *Commercial Real Estate* and *Vehicles*. This is consistent with the negative and statistically significant coefficients for *Liquid* and *Nondivertible* collateral in Table 3. Looking at the results in Column III, where the two selection channels are virtually eliminated, we observe that most of types of liquid and/or nondivertible collateral, such as *Pledged Deposits*, *Bank Guarantees*, *Creditor-Held Movable Assets* and *Collateral Bonds* maintain their negative and statistically significant coefficients, consistent with the empirical dominance of the “risk shifting” and/or “loss mitigation” channels for these collateral types.

Turning to our *ex post* nonperformance results, we observe that the overall positive relation between collateral and *ex post* nonperformance documented in Table 4 is mainly driven by collateral types that are neither liquid nor nondivertible, such as *Debtor-Held Movable Assets*, *Residential Real Estate*, *Commercial Real Estate*, and *Vehicles*. These types of collateral are positively related to *ex post* nonperformance, consistent with a dominant “lender selection” channel. Some desirable collateral types that are both liquid and nondivertible, such as *Pledged Deposits* and *Bank Guarantees*, are actually negatively related to *ex post* nonperformance. Since the “loss mitigation” channel is not present here, this finding, coupled with the results from the loan risk premium regressions in Column III suggests that a

“risk shifting” channel is especially important for these two types of collateral. Finally, none of the other types of collateral are found to have a statistically significant relation to *ex post* nonperformance.

Overall, our findings suggest that loans secured by most types of assets carry lower risk premiums than unsecured loans, with more desirable collateral (collateral types that were previously classified as liquid and/or nondivertible) carrying substantially larger discounts. Our results also suggest that the overall positive relation between collateral and *ex post* nonperformance reported above is principally driven by collateral types that are neither liquid nor nondivertible.

VI. Conclusions

A puzzle in the empirical literature is that loan risk and collateral are sometimes found to be positively related and other times found to be negatively related. This paper offers a potential solution to this puzzle by first highlighting four different risk-collateral channels implied by economic theory and then showing that the different channels are effective to different degrees depending upon the economic characteristics and types of collateral. Thus, the mixed results in the literature may reflect the fact that different studies use data samples with different mixes of collateral characteristics and types.

We find evidence supporting the economic importance of each of the four risk-collateral channels. For our sample, collateral overall is associated with reduced loan risk premiums that do not vary when strong controls for the “borrower selection” and “lender selection” channels are included. This suggests that the lower loan risk premiums are driven by the “risk shifting” and/or “loss mitigation” channels. In addition, *ex post* nonperformance is positively related to collateral, suggesting that the “lender selection” channel dominates the “risk shifting” and “borrower selection” channels. These results together imply that the “lender selection” channel is an important reason why collateral is pledged, and the “loss mitigation” channel is the main reason why loan risk premiums are lower for collateralized loans. Furthermore, the risk-collateral channels appear to depend upon the economic characteristics of collateral. The “lender selection” channel appears to be especially important for outside collateral, the

“risk-shifting” and “loss mitigation” channels are important for liquid collateral, while the “borrower selection” channel appears to hold weakly for nondivertible collateral.

Collateral does not appear to be homogeneous in its economic effects and hence future research should include information about the economic characteristics and/or types of collateral whenever possible. We also suggest that future research further investigate the four risk-collateral channels identified here.

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Table 1
Variables and Summary Statistics

The table reports the notation and definitions of variables used in the analysis and summary statistics for all loans in the sample. The summary statistics for *Ex Post Nonperformance* use the number of loans that matured before the end of the sample period.

Variables	Description	Obs	Mean	St. Dev.
Past Nonperformance				
<i>Prior_Default</i>	Equals one if the borrower had defaulted on a loan anytime in the previous 12 months with any lender, and is zero otherwise	28,252	0.003	0.052
<i>Prior_NPL</i>	Equals one if the borrower had overdue payments of at least 30 days with any bank anytime in the previous 12 months, and is zero otherwise	28,252	0.211	0.408
Firm Characteristics				
<i>Sole Proprietorship</i>	Equals one if the firm is a sole proprietorship, and is zero otherwise	28,252	0.126	0.332
<i>General Partnership</i>	Equals one if the firm is a general partnership (i.e., all partners have unlimited liability and ownership is not transferable), and is zero otherwise	28,252	0.008	0.091
<i>Limited Partnership</i>	Equals one if the firm is a limited partnership (i.e., some partners have limited liability and their ownership rights are transferable), and is zero otherwise	28,252	0.136	0.343
<i>Joint Stock Company</i>	Equals one if the firm is a joint stock company (i.e., all partners have unlimited liability and their ownership rights are transferable), and is zero otherwise	28,252	0.222	0.415
<i>Limited Liability Company</i>	Equals one if the firm is a limited liability company (i.e., all partners have limited liability and transferable ownership rights), and is zero otherwise	28,252	0.488	0.500
Relationship Characteristic				
<i>Rel_Length</i>	Length of bank-firm relationship in months	28,252	22.704	15.769
Loan Characteristics				
<i>Installment</i>	Equals one if an installment loan and zero if a discount loan	28,252	0.456	0.498
<i>Amount</i>	Loan amount at loan origination in US dollars	28,252	148,902	436,026
<i>Maturity</i>	Number of months between loan origination and maturity	28,252	10.757	12.833
<i>Interest Rate</i>	Annual contractual interest rate at loan origination	28,252	13.538	2.848
<i>Risk Premium</i>	Loan interest rate minus U.S. Treasury rate of comparable maturity at origination	28,252	9.507	2.557
<i>Collateral</i>	Equals one if collateral was pledged at loan origination, and is zero otherwise	28,252	0.177	0.381
Types of Collateral				
<i>Pledged Deposits</i>	Equals one if deposits were pledged, and is zero otherwise	4,989	0.091	0.287
<i>Bank Guarantees</i>	Equals one if bank guarantees or letters of credit were pledged, and is zero otherwise	4,989	0.037	0.188
<i>Securities</i>	Equals one if bonds or stocks were pledged, and is zero otherwise	4,989	0.022	0.146
<i>Creditor-Held Movable Assets</i>	Equals one if there is a possessory security on the firm's movable assets (e.g., inventory, crops, properties, tools, and equipment), and is zero otherwise	4,989	0.158	0.364
<i>Debtor-Held Movable Assets</i>	Equals one if there is a non-possessory security on the firm's movable assets (e.g., a/cs receivable, inventory, crops, properties, tools, and equipment), and is zero otherwise	4,989	0.248	0.432
<i>Residential Real Estate</i>	Equals one if a residential real estate is pledged, and is zero otherwise	4,989	0.199	0.399
<i>Commercial Real Estate</i>	Equals one if a commercial real estate is pledged, and is zero otherwise	4,989	0.088	0.283
<i>Collateral Bonds</i>	Equals one if a loan is secured with endorsements from deposit warehouses backed by the deposit of commodities ("Bonos de Prenda").	4,989	0.135	0.342
<i>Vehicles</i>	Equals one if vehicles were pledged, and is zero otherwise	4,989	0.023	0.149
Ex Post Loan Performance				
<i>Ex_Post_Nonperformance</i>	Equals one if a loan is 30+ days overdue anytime after origination or if it is downgraded to the default status (a rating of 5) and zero otherwise	25,918	0.059	0.237

Table 2
Mapping from Collateral Types to Economic Characteristics

Types of Collateral	Economic Characteristics		
	Liquid	Nondivertible	Outside
<i>Pledged Deposits</i>	1	1	0
<i>Bank Guarantees</i>	1	1	1
<i>Securities</i>	1	1	0
<i>Creditor-Held Movable Assets</i>	0	1	0
<i>Debtor-Held Movable Assets</i>	0	0	0
<i>Residential Real Estate_Limited Liability Companies</i>	0	0	1
<i>Residential Real Estate_Non Limited Liability Companies</i>	0	0	0
<i>Commercial Real Estate</i>	0	0	0
<i>Collateral Bonds</i>	0	1	0
<i>Vehicles</i>	0	0	0
<i>Percentage of Secured Loans</i>	14.3%	44.2%	14.7%

Table 3
Determinants of Loan Risk Premiums

This table reports OLS regressions for $Risk_Premium_{ijt}$, which is defined as the loan interest rate at loan origination minus the rate of U.S. Treasury bill with comparable maturities. Standard errors are corrected for heteroskedasticity using White standard errors and reported between brackets. ***, **, and * indicate significance at the 1%, 5%, and 10%, respectively.

	Baseline		(+) Firm Characteristics		(+) Firm*Bank*Time FE		(+) Firm*Bank*Time FE & Other Loan Characteristics	
	I	II	III	IV	V	VI	VII	VIII
Collateral								
<i>Collateral</i>	-0.600*** [0.044]	-0.413*** [0.059]	-0.580*** [0.043]	-0.431*** [0.056]	-0.636*** [0.096]	-0.466*** [0.171]	-0.525*** [0.097]	-0.317* [0.172]
Collateral Characteristics								
<i>Liquid</i>		-1.197*** [0.127]		-1.199*** [0.130]		-0.517** [0.255]		-0.643** [0.266]
<i>Nondivertible</i>		-0.242*** [0.084]		-0.165** [0.081]		-0.16 [0.188]		-0.189 [0.186]
<i>Outside</i>		1.073*** [0.111]		1.075*** [0.109]		-0.086 [0.244]		-0.102 [0.258]
Past Nonperformance								
<i>Prior_Default</i>			0.739*** [0.242]	0.700*** [0.242]				
<i>Prior_NPL</i>			0.468*** [0.029]	0.466*** [0.029]				
Firm Characteristics								
<i>General Partnership</i>			-0.403*** [0.137]	-0.441*** [0.137]				
<i>Limited Partnership</i>			-0.345*** [0.048]	-0.349*** [0.048]				
<i>Joint Stock Company</i>			-1.269*** [0.044]	-1.270*** [0.043]				
<i>Limited Liability Company</i>			-0.397*** [0.036]	-0.439*** [0.036]				
Relation Characteristic								
<i>Rel_Length</i>			0.037** [0.016]	0.045*** [0.016]				
Loan Characteristics								
<i>Installment</i>	0.077*** [0.027]	0.04 [0.027]	0.047* [0.026]	0.016 [0.026]	0.066 [0.049]	0.051 [0.049]	0.575*** [0.064]	0.566*** [0.064]
<i>Amount</i>							0.016 [0.021]	0.016 [0.020]
<i>Maturity</i>							-0.519*** [0.043]	-0.528*** [0.042]
Constant	11.117*** [0.099]	11.174*** [0.098]	10.793*** [0.127]	10.836*** [0.126]	9.247*** [0.025]	9.250*** [0.025]	9.837*** [0.205]	9.853*** [0.203]
Fixed Effects								
<i>Industry</i>			Included	Included				
<i>Region</i>	Included	Included	Included	Included				
<i>Bank</i>	Included	Included	Included	Included				
<i>Time (Month-Year)</i>	Included	Included	Included	Included				
<i>Firm*Bank*Time</i>					Included	Included	Included	Included
(Adjusted) R-squared	0.35	0.36	0.41	0.42	0.87	0.87	0.87	0.87
Observations	28,252	28,252	28,252	28,252	13,274	13,274	13,274	13,274

Table 4
Determinants of Ex Post Nonperformance

This table reports the marginal effects of Probit regressions for *Ex Post Nonperformance*, a dummy variable that equals one if a loan is 30+ days overdue anytime after its origination or if it is downgraded to the default status (i.e., given a rating of 5). For continuous variables we report the effect for an infinitesimal change in each independent variable and for dummy variables we report the estimated effect of a change from 0 to 1. P0 is the predicted probability of *ex post* nonperformance, evaluated at the mean of all independent variables. ***, **, and * indicate significance at the 1%, 5%, and 10%, respectively. The standard errors are corrected for heteroskedasticity using White standard errors.

	Baseline		(+ Firm Characteristics		(+ Firm Characteristics & Other Loan Characteristics	
	I	II	III	IV	V	VI
Collateral						
<i>Collateral</i>	0.035*** [0.005]	0.056*** [0.007]	0.028*** [0.005]	0.049*** [0.007]	0.028*** [0.005]	0.049*** [0.007]
Collateral Characteristics						
<i>Liquid</i>		-0.033*** [0.005]		-0.024*** [0.006]		-0.023*** [0.006]
<i>Nondivertible</i>		-0.023*** [0.004]		-0.025*** [0.003]		-0.025*** [0.003]
<i>Outside</i>		0.020* [0.011]		0.019* [0.011]		0.017 [0.010]
Past Nonperformance						
<i>Prior_Default</i>			0.02 [0.025]	0.02 [0.025]	0.017 [0.025]	0.018 [0.024]
<i>Prior_NPL</i>			0.061*** [0.004]	0.061*** [0.004]	0.063*** [0.004]	0.062*** [0.004]
Firm Characteristics						
<i>General Partnership</i>			-0.012 [0.010]	-0.012 [0.010]	-0.014 [0.010]	-0.014 [0.010]
<i>Limited Partnership</i>			0.016*** [0.006]	0.014** [0.006]	0.017*** [0.006]	0.015*** [0.006]
<i>Joint Stock Company</i>			-0.006 [0.004]	-0.005 [0.004]	-0.002 [0.004]	-0.002 [0.004]
<i>Limited Liability Company</i>			0.008** [0.004]	0.007* [0.004]	0.009** [0.004]	0.008* [0.004]
Relation Characteristic						
<i>Rel_Length</i>			-0.001 [0.002]	-0.001 [0.002]	-0.001 [0.002]	-0.001 [0.002]
Loan Characteristics						
<i>Installment</i>	0.024*** [0.003]	0.021*** [0.003]	0.022*** [0.003]	0.020*** [0.003]	0.017*** [0.003]	0.016*** [0.003]
<i>Amount</i>					-0.004*** [0.001]	-0.004*** [0.001]
<i>Maturity</i>					0.005** [0.002]	0.004* [0.002]
Fixed Effects						
<i>Industry</i>			Included	Included	Included	Included
<i>Region</i>	Included	Included	Included	Included	Included	Included
<i>Bank</i>	Included	Included	Included	Included	Included	Included
<i>Time (Month-Year)</i>	Included	Included	Included	Included	Included	Included
Pseudo R-Squared	0.094	0.1	0.154	0.159	0.134	0.139
P0	0.045	0.044	0.038	0.037	0.039	0.038
Observations	25,391	25,391	25,380	25,380	25,380	25,380

Table 5
Instrumental Variables Estimates of the Determinants of Loan Risk Premiums

This table compares instrumental variables (IV) and OLS estimates for $Risk_Premium_{ijt}$, which is defined as the loan interest rate at loan origination minus the rate of U.S. Treasury bill with comparable maturities. IV estimates are calculated using the Wooldridge (2002) procedure. Standard errors are corrected for heteroskedasticity using White standard errors and reported between brackets. ***, **, and * indicate significance at the 1%, 5%, and 10%, respectively.

	Baseline				(+) Firm Characteristics			
	OLS		IV		OLS		IV	
Collateral								
<i>Collateral</i>	-0.600*** [0.044]	-0.413*** [0.059]	-1.551*** [0.184]	-1.656*** [0.334]	-0.580*** [0.043]	-0.431*** [0.056]	-1.376*** [0.163]	-1.286*** [0.307]
Collateral Characteristics								
<i>Liquid</i>		-1.197*** [0.127]		-1.331*** [0.326]		-1.199*** [0.130]		-0.593** [0.299]
<i>Nondivertible</i>		-0.242*** [0.084]		-0.299 [0.356]		-0.165** [0.081]		-0.760** [0.329]
<i>Outside</i>		1.073*** [0.111]		1.116*** [0.284]		1.075*** [0.109]		1.473*** [0.213]
Past Nonperformance								
<i>Prior_Default</i>					0.739*** [0.242]	0.700*** [0.242]	0.892*** [0.250]	
<i>Prior_NPL</i>					0.468*** [0.029]	0.466*** [0.029]	0.495*** [0.031]	0.502*** [0.032]
Firm Characteristics								
<i>General Partnership</i>					-0.403*** [0.137]	-0.441*** [0.137]	-0.455*** [0.138]	
<i>Limited Partnership</i>					-0.345*** [0.048]	-0.349*** [0.048]	-0.400*** [0.049]	-0.413*** [0.050]
<i>Joint Stock Company</i>					-1.269*** [0.044]	-1.270*** [0.043]	-1.254*** [0.044]	-1.249*** [0.045]
<i>Limited Liability Company</i>					-0.397*** [0.036]	-0.439*** [0.036]	-0.438*** [0.037]	-0.492*** [0.038]
Relation Characteristic								
<i>Rel_Length</i>					0.037** [0.016]	0.045*** [0.016]	0.003 [0.018]	0.011 [0.019]
Loan Characteristics								
<i>Installment</i>	0.077*** [0.027]	0.04 [0.027]	0.115*** [0.028]	0.079** [0.034]	0.047* [0.026]	0.016 [0.026]	0.077*** [0.027]	0.021 [0.031]
Constant	11.117*** [0.099]	11.174*** [0.098]	11.140*** [0.101]	11.193*** [0.103]	10.793*** [0.127]	10.836*** [0.126]	10.901*** [0.130]	10.976*** [0.131]
Fixed Effects								
<i>Industry</i>					Included	Included	Included	Included
<i>Region</i>	Included	Included	Included	Included	Included	Included	Included	Included
<i>Bank</i>	Included	Included	Included	Included	Included	Included	Included	Included
<i>Time (Month-Year)</i>	Included	Included	Included	Included	Included	Included	Included	Included
Observations	28,252	28,252	28,252	27785	28,252	28,252	28,245	27,402

Table 6
Empirical Relation between Loan Risk and Collateral Types

This table reports results exploring the empirical relation between loan risk (loan risk premium and ex post nonperformance) and collateral types. OLS regressions are estimated for *Risk_Premium_{ij}*, which is defined as the loan interest rate at loan origination minus the rate of U.S. Treasury bill with comparable maturities. Marginal effects from Probit regressions are presented for *Ex Post Nonperformance*, a dummy variable that equals one if a loan is 30+ days overdue anytime after its origination or if it is downgraded to the default status (i.e., given a rating of 5). In both cases, standard errors are corrected for heteroskedasticity using White standard errors and reported between brackets. ***, **, and * indicate significance at the 1%, 5%, and 10%, respectively.

	Risk Premium (OLS)				Ex Post Nonperformance (Probit Model - Marginal Effects)		
	I	II	III	IV	V	VI	VII
Collateral Types							
<i>Pledged Deposits</i>	-1.692*** [0.123]	-1.773*** [0.126]	-1.168*** [0.272]	-1.160*** [0.289]	-0.023*** [0.008]	-0.017** [0.008]	-0.018** [0.008]
<i>Bank Guarantees</i>	-1.185*** [0.221]	-0.763*** [0.221]	-1.142*** [0.322]	-1.196*** [0.342]	-0.023** [0.011]	-0.020** [0.010]	-0.018* [0.011]
<i>Securities</i>	-0.718*** [0.183]	-0.820*** [0.184]	-0.403 [0.486]	-0.217 [0.415]	0.016 [0.025]	0.009 [0.022]	0.012 [0.023]
<i>Creditor-Held Movable Assets</i>	-0.965*** [0.097]	-0.822*** [0.096]	-0.823*** [0.140]	-0.658*** [0.139]	0.015 [0.009]	0.003 [0.008]	0.001 [0.007]
<i>Debtor-Held Movable Assets</i>	-0.820*** [0.089]	-0.657*** [0.081]	-0.597 [0.355]	-0.556 [0.359]	0.080*** [0.012]	0.062*** [0.010]	0.066*** [0.011]
<i>Residential Real Estate</i>	0.742*** [0.086]	0.558*** [0.084]	-0.156 [0.161]	0.093 [0.161]	0.051*** [0.013]	0.050*** [0.013]	0.047*** [0.012]
<i>Commercial Real Estate</i>	-0.368*** [0.120]	-0.496*** [0.119]	-0.406 [0.302]	-0.008 [0.290]	0.073*** [0.018]	0.077*** [0.018]	0.075*** [0.019]
<i>Collateral Bonds</i>	-0.343*** [0.082]	-0.332*** [0.083]	-0.382*** [0.121]	-0.318*** [0.113]	0.016 [0.010]	0.005 [0.008]	0.008 [0.008]
<i>Vehicles</i>	-0.157 [0.157]	-0.311* [0.165]	-0.353 [0.312]	0.049 [0.239]	0.058* [0.033]	0.071** [0.036]	0.060* [0.034]
Past Nonperformance							
<i>Prior_Default</i>		0.582** [0.236]				0.02 [0.025]	0.018 [0.025]
<i>Prior_NPL</i>		0.471*** [0.029]				0.061*** [0.004]	0.062*** [0.004]
Firm Characteristics							
<i>General Partnership</i>		-0.431*** [0.137]				-0.012 [0.010]	-0.014 [0.010]
<i>Limited Partnership</i>		-0.319*** [0.048]				0.013** [0.006]	0.014** [0.006]
<i>Joint Stock Company</i>		-1.213*** [0.043]				-0.005 [0.004]	-0.002 [0.005]
<i>Limited Liability Company</i>		-0.366*** [0.036]				0.008** [0.004]	0.008** [0.004]
Relation Characteristic							
<i>Rel_Length</i>		0.045*** [0.016]				-0.001 [0.002]	-0.001 [0.002]
Loan Characteristics							
<i>Installment</i>	0.024 [0.027]	0.007 [0.026]	0.046 [0.049]	0.565*** [0.064]		0.020*** [0.003]	0.016*** [0.003]
<i>Amount</i>				0.016 [0.020]			-0.004*** [0.001]
<i>Maturity</i>				-0.535*** [0.043]			0.004* [0.002]
Constant	11.063*** [0.095]	10.711*** [0.124]	9.248*** [0.025]	9.864*** [0.203]			
Fixed Effects							
<i>Industry</i>		Included				Included	Included
<i>Region</i>	Included	Included			Included	Included	Included
<i>Bank</i>	Included	Included			Included	Included	Included
<i>Time (Month-Year)</i>	Included	Included			Included	Included	Included
<i>Firm*Bank*Time</i>			Included	Included			
(Adjusted) R-squared	0.36	0.42	0.87	0.87			
Pseudo R-Square					0.1	0.159	0.139
P0					0.044	0.037	0.038
Observations	28,252	28,252	13,274	13,274	25,391	25,380	25,380